Seventh stage (♀ larvae only). Head pale yellow minutely mottled with grayish spots; labrum, antennae and a spot before the eyes, white; ocelli and jaws black; width 3.5 mm. The body is as in the previous stage, but the warts on the cervical shield are not distinctly darker. The dorsal blackish or pale gray shade is in triplicate on joints 3 and 4. Spiracles white in a fine black border. The body is often bright yellow, as are the dorsal tufts, and even the hair is yellowish.

Cocoon. Double, thin, made of silk and the hairs of the larva.

♂ *Pupa.* Cylindrical, the abdominal segments tapering, the eyes, wing cases and antenna cases especially prominent; a little depressed behind the thorax. Semi-transparent, shiny yellowish white, the back covered with long, thin, silky white hairs; cremaster flat, terminating in several brown hooks well fastened in the silk of the cocoon. Length 12 mm.; width 5 mm.

♀ *Pupa.* Robust, thickest through the 2nd to 4th abdominal segments, elsewhere smaller, of nearly even width; thorax and head small, no wing cases, leg cases small. Last segment rounded, cremaster flat, rather broad at base, terminating in a number of brown divergent hooks. Color semitransparent, shiny, very pale yellowish, without marks. Over the dorsum considerable fine, rather long, whitish silky hair. Length 18 mm., greatest diameter 8 mm.

♀ *Imago.* Of the same structure as *O. leucostigma*, but not white, the color of the down, which is especially abundant on the ventral side, being light brown. A small black spot on the second abdominal segment. The rudimentary wings are dark cinereous. The ♂ imago is very similar to *O. leucostigma*, but can be distinguished by its darker color and heavier black markings.

Food plants. Dr Thaxter gives oak, but I have found the species as omnivorous as *O. leucostigma*. My specimens were fed mainly on maple and witch-hazel.

THE GERM-BAND OF INSECTS.*

Those who have watched the advance in our knowledge of insect embryology during the past three or four years will be deeply interested in Prof. Graber's latest treatise. Like his muscid paper it represents many years' study, but unlike that work it covers a very considerable ground, being a comprehensive description of the germ-band of a number of insects. The species investigated belong to the genera: Lina, Lema, Telephorus, Melolontha, Hydrophilus; Pieris, Gastropacha, Bombyx, Zygaena; Hylotoma; Stenobothrus, Mantis, and Gryllotalpa. It will be seen that this list comprises representatives of four of the important orders. Prof. Graber treats of the formation and method of growth of the germ-band, its relations to the envelopes (amnion and serosa), its segmentation (both internal and external) and its appendages. Chapters are introduced on the formation of the germ-layers and on the origin of the body spaces. Many pages are given up to a minute and critical discussion of the results achieved by other investigators. The work concludes with a long chapter on the development of the nervous system.

In a brief sketch we cannot hope to do justice to the mass of matter with which Prof. Graber presents us; it will be possible to touch on only a few of the questions with which he attempts to deal. Before so doing

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a word must be said about the technique employed by Prof. Graber. As he informs us, and as is quite evident from his twelve large colored plates, his results were largely obtained from germ bands isolated from the yolk, stained *in toto* with carmine, and mounted in some resinous medium. His first plate shows that he has also examined Lina embryos unstained and *in situ* on the yolk. Now both of these methods, though useful for some purposes, are quite inadequate to decide any delicate question concerning surface relief, and have consequently been all but abandoned by some recent workers In point of detail Prof. Graber's surface views of Lina cannot stand comparison with some of the figures of insect embryos published decades ago, while nowhere is the inadequacy of his isolation method better shown than when he attempts to elucidate the structure of the brain. When represented at all in his figures this important organ is incorrectly represented. In order, therefore, properly to appreciate Prof. Graber's observations it is necessary to bear in mind that his technique is somewhat defective.

In the 15 quarto pages devoted to the nervous system there are many new and interesting facts, but we miss a careful treatment of the very earliest stages in the formation of the ganglia, both cephalic and ventral. It is safe to say that a few good sections through the nerve-cord of a sufficiently young Stenobothrus embryo would have brought out some interesting facts on the formation of the median and lateral cords—facts which would have induced the author to view the nervous system of the Coleoptera in a little different light.

A short time ago Prof. Graber devoted a paper to the important subject of metameric segmentation in insects. According to the observations therein recorded, the first segments to make their appearance in the embryo are not the definitive body-segments (*microsomites*), but segments nearly or quite corresponding to the imaginal aggregates of segments (head, mouth-parts, thorax, abdomen); the definitive segments being formed by a splitting up of these *macrosomites*. Although it occurred to Prof. Graber at the time that this phenomenon might be due to a foreshadowing of adult structure, he chose to adopt the view that the early macrosomitic segmentation was an ancestral feature. In his present paper he devotes considerable space to this subject, bringing out quite an array of pseudo-mathematical formulae, and, notwithstanding Heider's very sensible comments on his former paper, still persists in seeing some mysterious palingenetic trait in macrosomitic segmentation instead of an anticipation of the ultimate adult structure. That the latter is the correct explanation is shown by a study of Xiphidium. In this Locustid the definitive segments make their appearance in a wave which runs from the anterior to the posterior end of the germ-band. When the whole postoral portion of the germ-band has thus been split up into about eight segments, the remainder of the definitive segments are successively intercalated just in front of the caudal plate. Then, and not till then, does macrosomitic segmentation set in. Although this method of growth by intercalation of segments in front of the anal plate has been repeatedly shown to be the typical method in Annelids, Crustacea, Peripatus, Arachnids, Myriopods and, to a certain extent, in Hydrophilus (Heider), Prof. Graber maintains that it does not occur in insects. Strangely enough the very figures of Stenobothrus to which he appeals, prove the very opposite of his contention, for they show quite clearly that the youngest segment must lie just in front of the anal plate. The first indications of segmentation have probably escaped Prof. Graber,—it being impossible, as we have found after repeated trials, to detect them in semi-transparent, isolated germ-bands.

Prof. Graber divides insect embryos into microblastic and macroblastic, or long and short ones. Stenobothrus is microblastic;

Lina macroblastic. Apart from its being unscientific to classify things as big and little, it is difficult to understand how such a classification can be of any service whatsoever. There is a complete gradation between long and short germ-bands: in Stenobothrus the germ-band is very small when first outlined on the yolk; in Mantis and Oecanthus it is somewhat larger; in Gryllus still larger; in Blatta it is nearly as long as the egg; in other forms, like Musca and the Coleoptera, it is longer than the egg. But this is not a difference in the *germ-bands*, it is a difference in the amount of *yolk*. Stenobothrus has a direct development, Musca undergoes a profound postembryonic metamorphosis; the former needs a great deal of yolk because its embryonic development is long and complicated, the latter but relatively little yolk, because its embryonic development is very short and comparatively simple. Although Prof. Graber was aware of the existence of transitional forms between his long and short germ-bands, it seems never to have occurred to him while writing the ten long quarto pages, which he devotes to this and similar distinctions, that the true differences lie in the quantities of yolk with which different eggs are provided. This is a strange omission for an embryologist to make after all that has been said and written on the effects of yolk on development. *Verum operi longo fas est obrepere somnum.*

Equally artificial and useless is Prof. Graber's division of germ-bands into straight and crooked (tanyblastic and ankyloblastic). It is obvious that the curvature of a germ-band depends on the character of the yolk surface on which it happens to lie. Thus the germ-band of a spherical egg is necessarily curved (Phryganeidæ), while the germ-band on the long side of an elongate, oval egg will be more or less straight (Blattidae). It is somewhat disappointing to find that no attention is devoted to the important relations of the germ band to the micropylar axis, a subject on which Hallez has published two suggestive little papers (Comptes rendus, v. 101, 1885 and v. 103, 1886).

Prof. Graber finds the abdomen of the embryo insect to consist of *eleven* true segments. He believes that he has found distinct traces of coelomic cavities in the last (eleventh) segment, and figures them in Mantis and Hydrophilus. If correct, this observation is of great interest, since Haase has recently maintained, after an exhaustive study of the facts of larval and imaginal structure, that there are only ten segments in the insect abdomen, the "afterstück" not being a true segment.

The antennæ are shown by Prof. Graber to be decidedly postoral in their origin. Reichenbach pointed out that of the two pairs of antennae in Astacus the first arises on a level with the mouth, while the second is postoral. As far as their relation to the mouth is concerned, therefore, the antennae of insects would correspond to the second pair of antennae in Crustacea. The labrum arises, as Prof. Graber points out, from a pair of appendage-like organs. The honey-bee is cited as an exception to this general rule, the labrum of this species having been described as an unpaired appendage from the first. But Carrière has recently shown that the labrum of the wall-bee (*Chalicodoma muraria*) arises as a pair of papillae at first separated at their bases, but subsequently uniting to form a single piece. Prof. Graber has not succeeded in throwing any new light on the obscure question as to whether the labrum represents a pair of true appendages serially homologous with the antennae, mouth-parts, legs, etc.

A lengthy chapter is devoted to a consideration of the abdominal appendages of insect embryos. Among the numerous facts recorded the most valuable are those relating to *Hylotoma berberidis*. In this Tenthredinid the German investigator succeeds in establishing direct continuity between the embryonic abdominal appendages and the prolegs of the caterpillar-like larva. He finds that during embryonic life each of the eleven abdomidal segments presents a pair of appendages. Those on the 1st and 7th-9th segments soon disappear, while those on the remaining segments persist as the prolegs of the larva. The pair of appendages on the tenth segment, which are at the time of their origin in line (homostichous) with the appendages of the preceding segments, move pleurad, and thus become ectostichous. On the 11th segment the appendages ("afterspitzchen") are close together (entostichous). It is this last pair of appendages which corresponds to the anal legs of Lepidoptera, since, in the true caterpillars, according to Prof. Graber, the anal legs do not belong, as Haase and other investigators aver, to the *tenth*, but to the *eleventh* abdominal segment. Prof. Graber's figures are certainly far from being conclusive on this point. The peculiar cerci of Lyda belong to the tenth segment and are not therefore homologous with the anal legs of Lepidopterous larvae.

It is also interesting to note that the formation of the embryonic envelopes and the manner in which the dorsal body-wall is completed in the embryo Hylotoma strikingly resemble what is observed in Lepidoptera. This fact may prove to be of use as further evidence of a common ancestry for the Lepidoptera and Hymenoptera. The embryology of Hylotoma certainly appears to bear out the conclusion long since drawn from the adult structure of the Phytophaga, viz.: that this group is the most primitive among existing Hymenoptera. When we pass from a Tenthredinid to an Apid it appears that the embryonic envelopes show a tendency to become aborted, just as they do in the Diptera, in passing from an old form like Chironomus to a recent form like Musca. The general validity of this remark is in no wise impaired by the difference in the kinds of abortive change undergone by the envelopes in the two orders.

W. M. Wheeler.

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